A. True or False questions.

____ An experiment is a process whose outcome can be predicted with certainty.

____ The sample space of an experiment is only a fraction of the simple events of the experiment.

____ The probability of a simple event is always a number between 0 and 1; but the probability of a compound event can be any number between -1 and 1.

____ An event is a collection of some simple events.

____ The union of two events is the collection of simple events that are common to both events.

____ The complement of an event D is the collection of all simple events in the sample space which are not in event D.

____ The intersection of two events is the complement of the union of the two events.

____ Two events are mutually exclusive if they are not independent.

____ The simple events of an experiment are always mutually exclusive.

____ If two events are mutually exclusive, their intersection is empty.

____ If a coin has two faces: 'heads' and 'tails', then their probabilities are always ½ and ½, respectively.

____ If the conditional probability of an event A given B equals the unconditional probability of event A, then these two events are independent.

____ The event A and its complement A' are independent events.

____ The event A and its complement A' are mutually exclusive.

____ The compound event A'B is the collection of simple events common to both A and the complement of B.

____ The compound event (A ^ B)' is the collection of all simple events in the sample space but not in A nor in B.


B. Consider the experiment of rolling two fair dice once. Let A be the event that the sum of the two faces showing up is 9, and let B be the event that the sum of the two faces showing up
is at least 6. Answer the following:

i) Describe the sample space

ii) Find $P(A)$

iii) Find $P(B)$

iv) Find $P(A|B)$

C. The sample space for a given experiment has six simple events with probabilities as given in the table below.

<table>
<thead>
<tr>
<th>Simple events</th>
<th>Probabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>$E_1$</td>
<td>.15</td>
</tr>
<tr>
<td>$E_2$</td>
<td>.10</td>
</tr>
<tr>
<td>$E_3$</td>
<td>.05</td>
</tr>
<tr>
<td>$E_4$</td>
<td>.20</td>
</tr>
<tr>
<td>$E_5$</td>
<td>.35</td>
</tr>
<tr>
<td>$E_6$</td>
<td>.15</td>
</tr>
</tbody>
</table>

Find the probability of each of the following events:

i) $A$: \{E_2, E_4, E_5\}

ii) $B$: \{E_1, E_3, E_4, E_5\}

iii) $C$: \{E_2, E_6\}

iv) $AB$

v) $AB'$

vi) $A' \cap C$

vii) $B'\cap C'$

D. An individual's genetic makeup is determined by the genes obtained from each parent. For every genetic trait, each parent possesses a gene pair; and each contributes one-half of this gene pair, with equal probability, to their offspring, forming a new gene pair. The offspring's traits (eye color, baldness, etc) come from this new gene pair, where each gene in this pair
For the gene pair that determines eye color, each gene trait may be one of two types: dominant brown (B) or recessive blue (b). A person possessing the gene pair BB or Bb has brown eyes, while the gene pair bb produces blue eyes.

i) Suppose both parents of an individual are brown-eyed, each with a gene pair of the type Bb. What is the probability that a newborn child from this couple will have
   a) blue eyes?
   b) brown eyes?
   c) gene pair type Bb?

ii) If one parent has brown eyes, type Bb, and the other has blue eyes, what is the probability that a newborn child from this couple will have blue eyes?

iii) Suppose the mother is brown-eyed, type BB, and no information is available about the father's eye color. What is the probability that a newborn child from these parents has blue eyes?

E. Urn A has 6 blue and 4 red marbles, and urn B has 3 blue and 7 red marbles. Two marbles are selected at random (without replacement) from each urn. Find the probability that all four marbles are red.

F. The percentages of all teenagers aged 14 to 19 in two small communities fell in the following six community-delinquency categories:

<table>
<thead>
<tr>
<th>Community</th>
<th>A</th>
<th>B</th>
</tr>
</thead>
</table>

Suppose a teenager was chosen at random from one of the two communities, and let the events A, B, N, F and R represent the categories indicated in the table above. Find the following probabilities:

i) \( P(N') \)  

ii) \( P(FB') \)  

iii) \( P(AF \cap R) \)  

iv) \( P(\{\text{Teenager is not delinquent}\} \mid A) \)  

v) \( P(\{\text{Teenager is delinquent}\} \mid B) \)  

vi) \( P(F' \mid B) \)  

vii) \( P(F \mid N') \)